SECTION 500.00 – INTELLIGENT TRANSPORTATION SYSTEMS

SECTION 501.00 - GENERAL

501.01 General. Intelligent Transportation Systems (ITS) consist of a wide range of electronic devices and communications that promote the more efficient utilization of surface transportation systems. ITS is available for both transit and highway applications. Examples of ITS equipment for highway applications include:

- Roadway Weather Information Stations (RWIS)
- Dynamic Message Signs (DMS)
- Closed Circuit Television (CCTV) Systems
- Highway Advisory Radio (HAR) – see Section 187.15.03
- Traffic Management Centers (TMC)
- Traffic Detectors
- Call Boxes
- Commercial Vehicle Information Systems and Networks (CVISN)
- 511 Traveler Information Number
- Advanced Traffic Controller (ATC)

ITS communications are critical to the operations of the equipment. To standardize the communications, FHWA, NEMA (National Electrical Manufacturers Association) and the NTCIP Joint Standards Committee are engaged in an on-going standards development effort based on the National Transportation Communications for ITS Protocol (NTCIP). The NTCIP standards are a family of communications standards that govern the way various ITS equipment operate on a network. The goal of using NTCIP communications standards is "interoperability", where all ITS devices of the same type (DMS for example), are interchangeable with regards to network communications. In other words the ITS devices can be considered "plug and play".

The overall goals of planning and deploying ITS equipment include:

- Improve traffic safety
- Provide more efficient utilization of the highway system
- Mitigate congestion
- Improve management of incidents
- Provide relevant and timely information to motorists

SECTION 502.00 - DYNAMIC MESSAGE SIGNS

502.01 Introduction. Dynamic Message Signs (DMS) are traveler information devices used for warning, regulating, routing, and managing the motoring public in order to improve the traffic flow. The objective is to inform the driver of impending conditions with up-to-date information. The overall goal of DMS application is to provide permanent and temporarily located signs that can be programmed remotely to communicate to drivers the necessary information such that the driver can choose or be directed to the most appropriate route.

Dynamic Message Signs are able to convey a variety of information, which make them more effective in presenting current information on changing traffic conditions. It has been determined that motorists are less frustrated and aggravated when they are provided with information on the location of congestion and the expected length of delay to be encountered. This in itself tends to increase the safety and comfort of their trips as well as improve the overall efficiency of the system.

This document is written from a perspective of managing freeway traffic, but it applies to all state highways that employ Dynamic Message Signs. Therefore throughout this document the terms "roadway", "highway", or "interstate" may be substituted for "freeway".

502.02 Definitions.

- **Candela:** A unit of measure for luminous intensity, abbreviated "cd".

- **Character Matrix Sign:** A DMS that uses character matrixes (e.g., 5x7) with a fixed amount of blank space (no pixels present) between character matrixes to achieve the inter-character spacing. There is also blank space (no pixels present) between lines of characters to achieve the inter-line spacing.

- **Character Module:** A 5 x 7 set of pixels and shutters mounted onto a common surface to form one light-emitting character.

- **Comprehensibility:** A measure of how readily a driver can understand the DMS message.

- **Conspicuity (Target Value):** Distance at which drivers first notice the presence of a sign.

- **Contrast Ratio:** Ratio of the luminance of an object to the luminance of the background. In the case of DMS, contrast ratio is the ratio of the sign legend luminance to the sign background luminance.

- **Credibility:** The extent to which motorists believe that a DMS has a message that is reliable, accurate, and up-to-date.

- **Dial-Up Communications:** Remote communications with the DMS from a computer using modem and normal twisted-pair dial-up telephone circuit provided by the telephone company.

- **DMS Assembly:** The DMS assembly shall include the DMS, DMS case, sign controller unit (SCU) and associated equipment, supporting structures, a SCU roadside cabinet, ambient light photo sensor system, and all control and power cables between the DMS and the SCU.

- **Dynamic Message Sign (DMS):** A type of sign in which the message to be displayed can be created by changing each pixel independently. It includes the supporting structure, DMS case, contrast shields, point-to-point-wiring system between character modules, termination points for wiring to the DMS controller cabinet, service outlets, and photo sensors. Also called Variable Message Sign (VMS), Changeable Message Sign (CMS), or Electronic Message Sign (EMS)

- **Freeway Management (or Highway Management):** Control, guidance, and warning of traffic in order to improve flow of people and goods safely and efficiently, using predetermined goals and objectives, including those related to impacts on and the influence of surrounding communities.

- **Freeway Management System (or Highway Management System):** Utilization of infrastructure elements to accomplish goals and objectives of freeway management. Freeway management system elements include cameras, Dynamic Message Signs, ramp meters, traffic interchange signals, traffic operations center, hardware and software, operating staff, and policies and procedures.

- **Full Matrix Sign:** A type of DMS without fixed lines or characters. The entire display area contains equally spaced pixels.

- **Incident:** Any non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand. Such events include traffic crashes, disabled vehicles, spilled cargo, and special non-emergency events (e.g., ball games, concerts, parades, construction, maintenance or any other event that significantly affects roadway operations).

- **Management:** Systematic, planned, and coordinated use of human, institutional, mechanical, and technical resources to reduce the duration and impact of incidents, and improve the safety of the traveling public, crash victims, and incident responders.

- **Informational Unit:** Each separate data item given in a message, which a motorist could recall and use for decision-making.

- **Legibility Distance:** The greatest distance from a DMS, at which people with normal (20/20) visual acuity can read a message.

- **Light-Emitting DMS:** A DMS that generates its own light on or behind the viewing surface. This sign requires power at all times when a message is displayed.

- **Line Matrix Sign:** A type of DMS in which there are not fixed blank (no pixels) spaces between characters. The entire line contains columns of pixels with a constant horizontal pitch across the entire line.

- **Lumen:** The unit of luminous flux emitted in a solid angle of one steradian by a uniform point source that has an intensity of one candela.

- **Luminance:** The intensity of light per unit area at its source, usually measured in candela per square foot (square meter). Luminance is a measure of light coming from a surface. The luminance of a light source (e.g., lamp) is an exact measure of the light it emits. Illumination, on the other hand, is a measure of light falling on a surface.

- **Lux:** A measurement of light. A unit of illuminance produced on a surface area of one square meter by a luminous lux of one lumen uniformly distributed over the surface. (1 lux = 1 lumen per square meter).

- **Message Format:** Arrangement of units of information on a sign to form the message.

- **Message Length:** Number of words or characters in a message.

- **Message Unit:** Units of information; e.g., USE NEXT EXIT is a three-wordunit.

- **Over Irradiation:** A phenomenon resulting from extremely high luminance contrast where the lighter surface tends to "bleed" onto the darker surface.

- **Pitch:** The center-to-center distance between two adjacent pixels, that can be measured either horizontally or vertically.

- **Pixel:** The smallest independent controllable visual element of a DMS.

- **Shutter:** A device that completely prohibits and/or allows the emission of light from the optical fibers when the lamps are on.

- **Shuttered Fiber-Optic DMS:** A DMS that uses optical fibers to direct light (from halogen lamp) to form 5 x 7 character modules on the sign face. Each pixel with two fiber-optic dots has a corresponding shutter that rotates to either permit light from the halogen lamps to pass through the fibers to form the message, or to block the light.

- **Sign Height:** The height of a sign including borders. 

- **Sign Width:** The width of a sign including borders.

- **Stored Message:** All messages (i.e., permanent, changeable, and volatile) located in a sign controller.

- **Stroke:** The width or diameter of a pixel.

- **Text:** The characters used to create a message.

502.03 Authorized Personnel.

1. In each ITD district, a primary and two (or more) back-up persons (primary back-up and secondary back-up) should be designated by the District Engineer as having authority ("authorized person", and "back-up authorized persons") to determine what standard and special messages are to be displayed on Dynamic Message Signs. The primary back-up authorized person will act in the absence of the authorized person and the secondary back-up person shall act in the absence of the authorized person and the primary back-up person.

2. Districts may elect to transfer day shift and/or after-hour operations of DMS to the State Communications Center for specific, pre-approved messages and under specific procedures. This arrangement would be effected by MOU, fully describing the transfer of DMS control. All requests for message postings should be made to the State Communications Center, who will either post the message or notify the authorized personnel.

502.04 DMS Applications. DMS are used during the following conditions:

1. Recurring Conditions

   Mainly peak-period traffic congestion where demand exceeds capacity for relatively short periods of time.

2. Non-recurring Conditions

   Caused by random or unpredictable incidents.

502.05 DMS Benefits.

- Reduction of speeds as vehicles approach congested areas, resulting in fewer crashes.
- Increased diversion from primary routes during downstream incidents.
- Advanced lane changes away from lanes that are closed downstream.
- Increased throughput for commercial traffic ports-of-entry due to vehicles queuing in the correct lane.
- Improved traffic operations during special events.
- Provide selected safety and public service information.

502.06 Sign Location and Installation. The most critical locations for installing permanent DMS are in advance of interchanges or highways where drivers can have the opportunity to take some action in response to messages displayed on DMS. A DMS should not compete with existing roadway signs. At times, relocation of some static signs may be required in order to install a DMS at a critical location.

Drivers generally do not anticipate using a different route until they see and read a DMS re-routing message. Drivers who are traveling in the inside lanes need ample time to read the message and change lanes to exit.

In general, a DMS should be permanently installed at the following locations:

- Upstream from major decision points (e.g., exit ramps, freeway-to-freeway interchanges, or intersection of major routes that will allow drivers to take an alternate route).
- Upstream of bottlenecks, high-accident areas, and/or major special event facilities (e.g., stadiums, convention centers).
- Where regional information concerning weather conditions such as snow, ice, fog, wind, or dust is essential.

502.07 DMS Classifications.

1. Technologies

   DMS are classified into the following three different categories:

   a. Light-Reflecting

      This type of DMS (e.g., reflective disk, rotating drum) reflects light from some external light source such as vehicle headlights or the sun. This sign needs power only when the message is changed or for the operation of environmental equipment such as fan and heater.

   b. Light-Emitting

      This type of DMS generates its own light on or behind the viewing surface, requiring power at all times when a message is displayed. The more common types of light-emitting DMS are bulb matrix, fiber-optic matrix, and light-emitting diode (LED) matrix.

   c. Hybrid

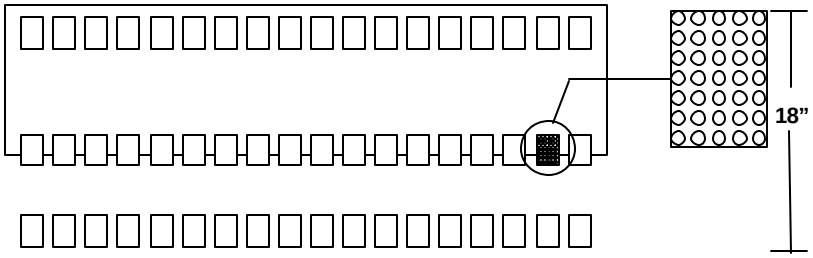
      This type of DMS combines the technologies of the two aforementioned DMS; for example, some manufacturers have integrated fiber-optic or LED with reflective disk matrix technologies.

2. Display Format

   DMS display characters and symbols in a matrix format, which are generally designed in the following three patterns:

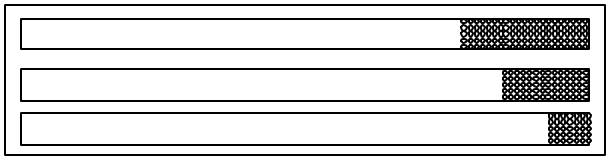
   a. Character Matrix

b. In this format, each character of the desired message is composed of a 5 x 7 matrix of pixels. The number of characters per line varies, depending on the manufacturers and the desired usage, although most transportation agencies deploy three-line, 18-character DMS. Practically all highway DMS display messages use capital letters because the configuration of the 5 x 7 matrix does not lend itself to displaying lower-case letters. The maximum viewing distance is approximately 900 feet (270 m).



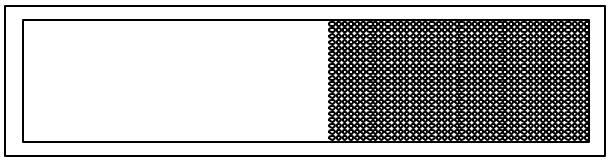
b. Line Matrix

In this format, the display lines are separate from each other, with each line consisting of continuous matrix of pixels, as shown below.



c. Full Matrix

In this format, the entire display consists of continuous matrix of pixels, as shown below.



It should be noted that although line matrix and full matrix DMS provide flexibility in displaying different characters and symbols varying in sizes, it has been shown that in many cases, fewer characters can be displayed on a line of continuous matrix or full matrix DMS than can be displayed on a line with character matrix because of the width required for proportional characters.

502.08 Visibility and Legibility Criteria.

1. General

The ease with which a sign can be detected in the environment (conspicuity) and the ease with which the message can be read (legibility) will enhance the effectiveness of motorists' visibility of the DMS and its message. In addition, the manner in which the message is displayed must be considered; e.g., if the message is too luminous, it can be easily detected but difficult to read because of glare.

2. Factors Affecting Legibility

Factors that affect the legibility of light-emitting DMS include the character height; font style; character width (spacing and size of pixels); spacing of characters, words and lines; size of sign borders; and contrast ratio.

502.09 DMS Message Characteristics.

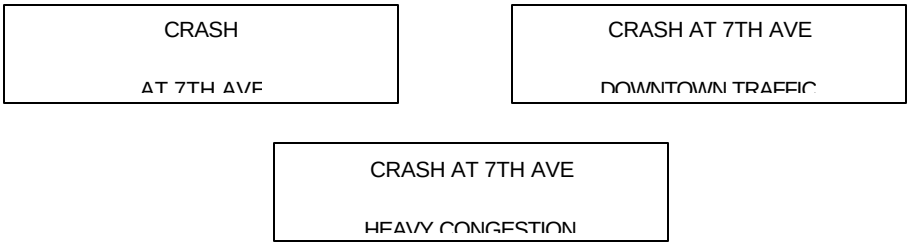
1. Message Content

In general, a DMS message consists of a combination of the following elements:

Question	Statement	Example
What happened?	Problem	Accident
Where?	Location	At 7th Avenue
What effect on traffic?	Effect	Heavy congestion and delay
For whom is the message intended?	Attention	Downtown traffic
What is advised?	Action	Exit at 19th Avenue

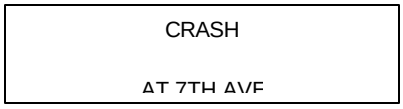
Many DMS are capable of accommodating 18 characters per line (including spaces), with three lines per display; thus a total of 54 characters may be used to display a message on a DMS. It is therefore obvious that a single message could not display all of the information shown in the above example.

In a situation such as the one shown above, one of the following single messages could be displayed depending on circumstances:



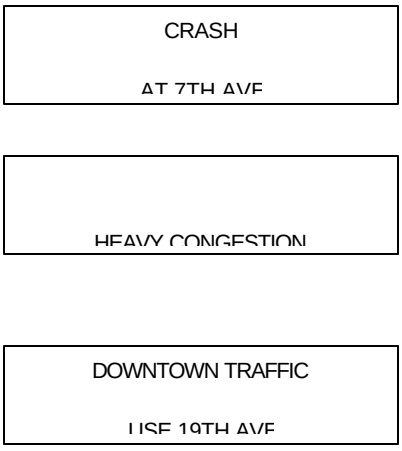
2. Message Format

Message format refers to the arrangement of the informational units on a DMS to form a total message. Compatibility must be maintained between words within a line and between message units on a DMS. Because of limitation of many DMS, which allow only three lines of messages to be displayed (18 characters per line), the following message best represents the above condition.



3. Message Splitting (Chunking)

Occasionally, the required message may be too long to be processed by drivers viewing the DMS at high speeds. To avoid overwhelming the drivers under these circumstances, a long message may be broken (chunked) into compatible informational units. The example in Section 9.b can be chunked into the following compatible phrases:



Note that HEAVY CONGESTION and DOWNTOWN TRAFFIC are not compatible phrases, and therefore should not be chunked together.

4. Viewing Time

Reading Time is the length of time it actually takes a driver to read a DMS message. Exposure Time is the length of time a driver is within the legibility distance of the DMS message; that is, it is the maximum available time to the driver to read a message. The exposure time, therefore, must always be equal or greater than the reading time, and is directly related to message legibility distance and driving speed.

An 18-in.-high character DMS will provide approximately 8 seconds of exposure time when the freeway operating speed is 55 miles per hour. As the conditions change, such that the driver has less time to read the DMS message, then the message length must be reduced accordingly. The following is a summary of guidelines related to viewing time.

a. The DMS message must be legible at a distance that allows sufficient exposure time for drivers to view it a sufficient number of times to read and comprehend it.

b. Studies show that an 8-word message (about four to eight characters per word), excluding prepositions such as "to," "for," "at," etc., approaches the processing limits of drivers traveling at high speeds.

c. On the average, a minimum exposure time of one second per short word (excluding prepositions) or two seconds per line, whichever is greatest, should be used for unfamiliar drivers.

502.10 DMS Message Usage.

1. General

a. DMS must provide reliable, accurate, and up-to-date information to motorists so that credibility is maintained. Unlike static regulatory, warning, and guide signs, which always provide the same messages regardless of the traffic conditions, DMS messages elicit different driver expectations.

b. DMS messages should be displayed only when unusual conditions exist and some responses by the drivers are required (i.e., change of speed or route).

c. The DMS system will work only if the drivers believe in its operational credibility; otherwise, they will ignore the messages. The most elaborate system will fail if the drivers lose confidence in its operation.

d. It is important that the message displayed is reliable. It would be better to display less information or no information if the operator is unsure of the traffic conditions. It is also important that the operator change or remove the message with changing conditions.

e. If an alternate route is recommended, the operator must make sure it will result in significant improvement in travel. The alternate route requires constant monitoring to ensure it does not become a new incident.

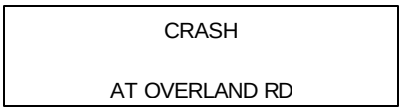
f. The drivers should not be informed of something they already know; for example, a message, stating that there is congestion ahead (when the drivers are already experiencing the problem) will result in many drivers ignoring the DMS messages even when important information is provided.

g. A level of trust must be created with the motoring public. Motorists do not accept and believe a DMS simply because it is located along the highway. Once the trust of motorists is gone, it is much more difficult to gain it back.

h. The operator should first make an attempt to use an existing message stored in the library, which is appropriate for the desired DMS and its location.

i. When messages are requested by other parties to be created by the District, the operator shall review the message content, format and display schedule with the authorized person or back-up authorized person prior to displaying the message.

j. For urban freeways, the incident location reference should be the nearest cross-street, as shown below.



k. For rural highways, the incident location reference should be the route and milepost designation, as crossroads are usually nonexistent in rural areas.

2. Pre-Warning

Pre-warning messages, announcing future construction or maintenance conditions, will be displayed according to the following criteria:

a. Full roadway closure.

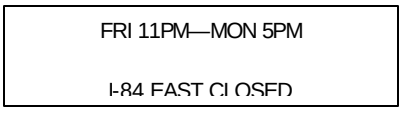
b. Major roadway restriction prior to 11:00 p.m.

c. Forty-eight hours advanced notice required prior to message display to obtain approvals and program DMS controllers.

d. The three lines of each DMS will display the message based on the following criteria:

Example:

Line 1: Duration



Line 2: Effect

Line 3: Location

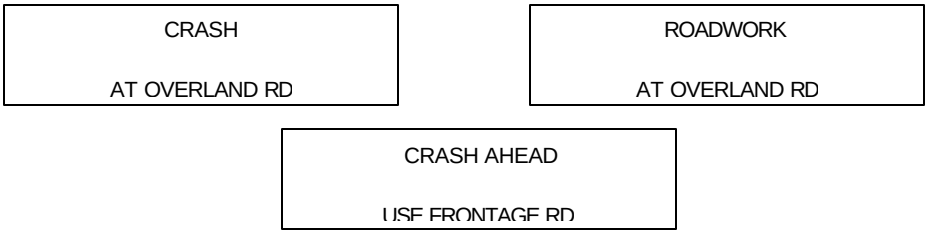
3. Unplanned Incident

   a. The drivers should be informed about the nature and location of the incident.

   b. The severity of an incident should be described in terms of number of lanes blocked, delay (e.g., major or minor), or congestion.

   c. General terms such as CRASH or ROADWORK, should normally be used, as these words will eliminate the need for a library of messages for every conceivable incident.

   d. For urban freeways, the incident or congestion location reference should be the nearest cross-street, as shown below.



   In urban areas, the message normally does not inform the drivers to use a cross-street as an alternate route.

   e. For rural highways, the incident location reference should be based on the route and milepost designations, as shown below.

   In rural areas, an alternate route may be displayed on a DMS message to guide the drivers, if pre-authorization of the local jurisdiction has been obtained. The alternate route should primarily be on a State highway system and its route number must be provided in the message. The local name of a rural highway should not be provided as a replacement for the route number; for example, YELLOWSTONE AVENUE should not be used for US 20.

   If city names are used in a DMS message, they should be identical to those used on static highway signs.

   f. When the incident is <u>not</u> on the same highway where the DMS is located, the following messages may be displayed:

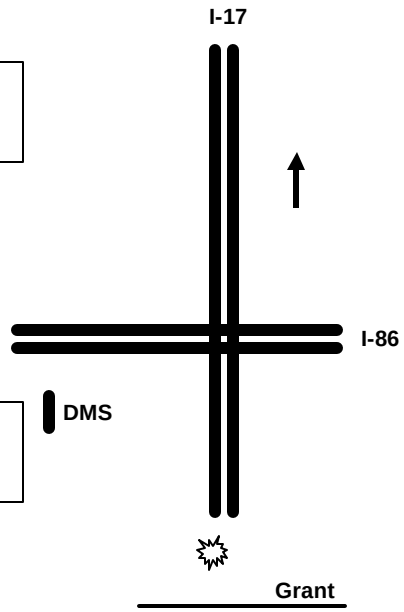
Example 1:

Line 1: Location

Line 2: Problem

Line 3: Action

I-15 SOUTH
CRASH AT GRANT



Example 2:

Line 1: Location

Lines 2: Problem

Line 3: Effect

I-15 SOUTH
AT GRANT

g. When the incident is <u>on</u> the same highway where the DMS is located, the following messages may be displayed.

Example 1:

Line 1: Problem

Line 2: Location

Line 3: Effect

CRASH
AT OVERLAND

Example 2:

Line 1: Effect

Line 2: Effect

Line 3: Location

RIGHT LANE
CLOSED

h. Do not display messages for incidents, which do not block the roadway (e.g., spilled load or dead animal on the shoulder).

i. When the highway has two or three lanes in one direction, and there is a blockage, the following texts should be used in the message, as applicable:

- LEFT LANE BLOCKED
- RIGHT LANE BLOCKED

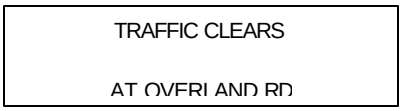
- CENTER LN BLOCKED or CNTR LANE BLOCKED

  The word BLOCKED should be used for temporary blockage (less than 4 hours); the word CLOSED should be used for extended closure. The message FREEWAY BLOCKED must not be used unless all the lanes are blocked.

j. When the roadway has four or more lanes in one direction, and there is a blockage, the words LEFT, RIGHT, or CENTER are applicable if the incident has occurred in either of these lanes; otherwise, the following texts may be used in the message, as applicable:

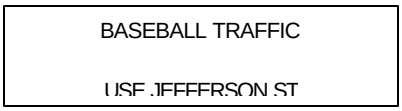
- KEEP LEFT
- KEEP RIGHT
- STAY IN MIDDLE

k. It is best to use positive words rather than negative statements in the message; for example, once the congestion has been cleared, a message, such as the one below, may be used:

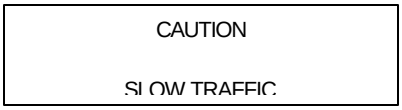


l. Based on the available information from the field personnel, it may be useful to use the words MAJOR DELAY or MINOR DELAY in a message. Although such descriptions do not provide precise delay information to motorists, they will nevertheless imply the severity of the congestion to the majority of the drivers.

m. The word TRAFFIC should be used in conjunction with specific traffic generators, as shown in the example below.



n. When incidents occur, high-speed traffic should be alerted of stoppages and queues of slow-moving traffic in order to reduce rear-end collisions. In these situations, the recommended DMS message could be as shown below.



4. Special Events, Construction and Maintenance Work

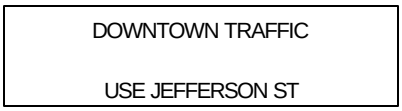
Ballgames, parades, concerts, construction and maintenance etc., have specific schedules, which describe starting and ending times. It is important that those DMSs, which must be use to inform motorists, be activated and deactivated in a timely manner.

Example:

Lines 1: Attention

Line 2: Action

Line 3: Blank



5. Non-Incident Conditions

Non-incident messages include safety or public service information and do not require the driver to make any unexpected actions regarding the traffic conditions. Examples of these messages include "Buckle Up," "Don't Drink and Drive"," Ride Bus or Carpool" and "Amber Alerts." Other types of messages included under this category are displaying the time, date, test, and expected travel time to a designated point during congestion.

In general, DMS used for non-incident conditions should adhere to the following three conditions:

- Keep the DMS blank.
- Display pre-approved public service messages.
- Display test messages to show the DMS is working.

DMS should not **routinely** display messages unless an incident has occurred or a safety issue warrants displaying a message for motorist information. If, however, non-incident-related messages are to be displayed occasionally, the following guidelines should be followed:

a. Obtain the written approval of the Chief Engineer or designee prior to displaying the message.

b. Display the message during specific time periods (i.e. 1 hour each during morning and evening rush hours or no longer than 2 hours for immediate messages). Safety related messages should coincide with annual campaigns and not be displayed for more than four hours (two hours each for morning and evening) per day for three consecutive days. Safety related messages may be displayed again for a second 3-day period after a break of 4 days.

c. Determine which DMS are the best candidates to display the message; in other words, generally do not display the message on all DMS.

d. Do not display controversial messages.

e. Make sure the information displayed is different from an incident-related message, i.e., motorists should not consider the message as important information to make drastic decisions.

f. Make sure the message does not create controversy, which may result in a liability issue.

g. If a phone number is displayed it shall be a prefix plus acronym type (i.e. 345-RIDE), rather than the seven digit number.

h. An incident-related message has precedence over non-incident-related information. See Section 12. DMS System Priorities below.

i. Advertising is not permitted on any DMS.

j. A flashing pixel shall be displayed to indicate the DMS is available for message posting.

502.11 Warrant Criteria For Displayng Traffic Messages.

1. Because Dynamic Message Signs are high profile devices specifically designed to attract drivers' attention, it is recommended that they be used to display messages only when traffic conditions warrant, otherwise the signs should remain blank. Also, DMS should not be used to display the same message day in and day out, unless the message concerns an extended road closure (such as SH 21 during the winter avalanche season). If this becomes the case, use of a static sign should be considered. This will help promote driver confidence that if the signs are displaying a message, then the information warrants drivers' attention regarding traffic conditions.

2. The warrants stated in this section identify specific traffic conditions for which DMS may be used to communicate information to drivers. The traffic conditions identified in the warrants represent thresholds for which it is recommended, not mandated, that action be taken in the form of using the DMS to provide drivers with information concerning the traffic conditions. A summary of the warrants are provided in Table 1, below.

Table 1 – Summary of DMS Warrants

Application	DMS Type	Warrants
Traffic Management	Freeway (Permanent)	1) *Freeway speeds have fallen below 45 mph for more than 15 minutes or across two or more consecutive traffic monitoring stations resulting in congested traffic.* 2) *Any time freeway speeds fall below 30 mph for a period of 5 minutes.* 3) *Construction or maintenance activities which reduce the capacity of the freeway.* 4) *The existence of work zones on the freeway which require work vehicles to merge in and/or out of freeway speeds.* 5) *Geometric changes requiring traffic channeling, merging or weaving patterns that are temporary and different from the normal alignment* 6) *When anticipated demand exceeds capacity in localized areas due to traffic destined for high impact special events.*
	Portable (Temporary)	1) *Construction activities are present which reduce freeway or surface street capacity* 2) *Geometric changes requiring traffic channeling, merging or weaving patterns that are long term and different from the normal alignment* 3) *Special event traffic volumes creating excessive demand on surface street capacity based on circulating traffic looking for parking.*
Incident Management	Freeway (Permanent)	1) *The occurrence of an incident which reduces the capacity of a freeway.* 2) *The occurrence of an event adjacent to the freeway which threatens health and/or safety of drivers on the freeway.* 3) *The existence of a disabled vehicle on either shoulder of the freeway which is causing queuing and/or reduction of speeds below 55 mph to occur upstream from that point.* 4) *Debris on any portion of the travel lanes of a freeway*. 5) *Civil defense emergencies*
	Portable (Temporary)	1) *The occurrence of an incident which reduces the capacity of a freeway and is projected by an Incident Management Team member, to last for a duration longer than 2 hours.* 2) *The occurrence of an event on or adjacent to the freeway which threatens health and/or safety of drivers on the freeway (e.g. Hazmat spill) which is projected to last for a duration longer than 2 hours* 3) *Civil defense emergencies*
Environmental Conditions	Freeway (Permanent)	*1) A reduction in visibility to 1000 feet or less (due to either fog or dust).* 2) *The existence of icy pavement conditions.* 3) *The existence of high wind conditions.*

3. To maintain credibility and message accuracy, traffic conditions should always be verified prior to the display of a message. Verification confirms that warrants have been satisfied and that conditions exist which require the use of DMS. Verification may be provided using CCTV cameras, traffic detection stations, law enforcement officers, incident management personnel or other emergency personnel.

4. Alternatively, when to remove a message is equally important to effective DMS operation. The point is to always have messages maintain their relevance to the intended audience. In this way messages don't become dated, stale, or inaccurate. The goal is to have drivers implicitly trust the messages they read and actively seek out and react appropriately to the information presented.

5 Given the variety of warrants provided above which provide criteria for when to put a message up, whenever any warrant is unfulfilled for a period of 15 minutes after a message has been displayed relative to that warrant, the display of that message should be terminated.

502.12 DMS System Priorities. Real-time DMS operations can become very fast paced and the operating environment can be quite dynamic. The variability of conditions on the road opens up the potential for conflict in terms of which situations will be handled in what order. This potential for conflict requires that priorities be established concerning which types of events should be handled first in a situation where several incidents and/or traffic conditions are occurring simultaneously. Prioritizing which types of events are to be dealt with, and in what order, helps to eliminate confusion and loss of time in critical situations. For this reason the following order of priority has been developed as a guide for authorized persons and back-up authorized persons who will be responsible for managing the DMS system.

Priorities (Listed in order of importance):

1. Traffic Related Emergency Situations. Safety is the first priority. This means that any messages that are directly related to safety of the traveling public are given first priority for display. Notable examples of this are emergency situations where highway closures are required due to hazardous materials spills which pose clear threat to life and property.

2. Incidents. Primarily accidents where injuries have occurred and/or lanes are blocked. This also includes incidents where the potential for injuries exists due to occupied vehicles becoming disabled and blocking traffic lanes that should otherwise be open for travel.

3. Traffic Management. This includes major congestion delays, road, lane, or ramp closures regardless of the reason for the closure because these types of closures directly impact the route a driver would take. Road conditions related to weather are also included here.

4. Minor Traffic Impacts. The fourth priority is information on minor traffic impacts. Minor traffic impacts include construction lane closures, maintenance activities which slow traffic, and delay information.

5. Non-incident Messages. The fifth priority is non-incident messages, including "Amber Alerts", seat belt campaigns, and Ozone alert-carpool. Use of these messages requires approval prior to displaying (see Section 10.E, Non-Incident Conditions, above).

6. Test Messages. The last priority is the use of test messages. Usually the timing for display of this type of message is discretionary and may be done at a time when distraction to drivers can be minimized.

502.13 DMS Usage Documentation.

1. Records shall be kept of the total number of messages displayed, as well as the types of messages (e.g., incident; pre-planned, such as construction, maintenance, special event; emergency; and public information). In addition, documentation should be made of the date and time messages are activated, deactivated, changed, closed, duration, etc.

2. Information regarding the DMS location; date and time of message activation, deactivation, duration; and authorized person (or back-up authorized person) shall be recorded. Also a notation of the message and any changes that were transmitted to the State Communications Center dispatch shall be recorded.

3. Any sign malfunctions and date of repair shall be noted and kept on file for three years.

4. All information should be stored electronically in a database so that the information can be used for future analysis and evaluation.

501.14 Word Usage. Although the verbs USE, TAKE, and FOLLOW are basically synonymous, they should be used based on the following criteria:

1. The verb USE should be used when the suggested route will take the driver to his/her destination. USE is also a preferred word because it is slightly shorter.

   Example: USE US-89 FOR BYPASS

2. The verb TAKE should be used when the driver is informed to take the first segment or leg of a route.

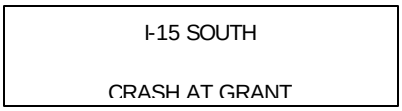
   Example: TAKE NEXT EXIT

3. The verb FOLLOW should be used when subsequent reference signs and trailblazers will guide the driver.

   Example: FOLLOW MARKED ROUTE

4. The verb STAY should be used when the driver is advised to continue traveling on a route.

   Example:



5. The verb EXIT should always be followed by the freeway exit number or the name of the cross-road.

   Example: USE EXIT 223

6. The verbs GO and TURN should not be used.

7. The word BYPASS generally implies that the driver will eventually return to the primary route.

8. In general, punctuations should not be used in DMS messages; however, prepositions may or may not be used depending on the circumstances, as shown below.

SIGN **IS** UNDER TEST	SIGN UNDER TEST
Not Recommended (IS is not necessary)	Recommended
ACCIDENT AT OVERLAND RD	CRASH AT OVERLAND RD
Not Recommended (Period after RD is not necessary)	Recommended (Note that AT is used)

502.15 Abbreviations. Because of the limitations associated with the DMS display (e.g., 18 characters per line and three lines per display), the operator may occasionally need to shorten the message by using abbreviations so that relevant information can fit the allowable space. It is important that meaningful and readily understood abbreviations be used so that the drivers are able to quickly comprehend the intended information. See the MUTCD, Section 1A.14, for applicable abbreviations.

SECTION 503.00 – CALL BOXES

503.01 General. Call boxes are intended to provide emergency communications to a dispatcher in remote areas where no other means of communications exist. Call box deployment should be considered as possible additions to road construction projects in remote areas.

503.02 Objective. The long term objective of ITD is to expand the areas along the state highway system that have cell phone coverage. To this end, Districts are encouraged to promote partnerships with wireless providers to offer access to right-of-way to expand cell phone coverage.

Recognizing the limitations in range and the subsequent unfavorable business case for cell tower deployments in mountainous areas, call boxes represent a low cost solution for emergency communications in these areas. Note that call boxes are only for roadside to dispatcher communications and cannot be used for general telephone communications.

Before proceeding with a call box component in your proposed project, check with the Public Utilities Commission to confirm that no plans are being made for cell tower deployment in the region of your project.

503.03 Implementation.

1. Where Needed:

   Typical call box deployment would be in remote areas where conventional communications (public telephone and cell phone) access is not available. Usually call boxes rely on a wireless link to a communications backbone (either wireless or wire line). Therefore the proposed deployment must consider the availability of a propagation path to an established communications network.

   Candidates for call box deployment would be highway segments that have a history of incidents that don't get reported promptly.

2. Coordination:

   It is important to identify early in the project development who will be responding to the call box user. In remote areas, local law enforcement may be the first responders to emergency communications, so all call box deployments would be coordinated with them. Also consider the feasibility of having a local agency install and maintain the call boxes.

3. Placement:

   Call boxes shall be placed on the right side of the highway and adequate shoulder parking shall be provided at the call box location to allow motorists (including truckers) to safely park their vehicle while using the call box.

4. Standard Features:

   For uniformity statewide, specify that the boxes be painted yellow. A suggested product is the **Mac One** from Connectivity, Inc. See http://www.connectivityinc.com/prod_list.shtml for more information. The call box is actuated by pushing a button to talk and releasing the button to listen. Also, the call box Identification/Location is automatically sent to the dispatcher when the call box door is opened.

5. Signage:

ALL W/BL

D12-3

D12-301

D12-302 L/R

D12-301 and D12-302L/R should be placed on both sides of undivided highways to identify the call box location for both directions of travel. No signing should be placed on the opposite side of a divided highway.